EVALUATING CONSTRUCTION ACTIVITIES IMPACTING ON WATER RESOURCES: PART 1

GUIDELINES FOR CONSTRUCTION OF HYDROCARBON TRANSMISSION AND DISTRIBUTION PIPELINES CROSSING WATERCOURSES

March, 1984

Ministry
of the
Environment
Ontario

EVALUATING CONSTRUCTION ACTIVITIES IMPACTING ON WATER RESOURCES: PART I

GUIDELINES

FOR

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CONTENTS

FOREWORD

In 1976, the Ontario Ministry of the Environment (MOE) published the handbook "Evaluating Construction Activities Impacting on Water Resources" to be used in the assessment of the environmental impacts of construction activities. The environmental impacts from construction were poorly understood at that time and it was indicated that the handbook would be revised as new information became available. The considerable experience gained since 1976 now warrants that the original publication be revised to reflect current knowledge.

These guidelines for the construction of transmission pipelines crossing watercourses form the first of five parts of the revised 1976 handbook. The remaining parts, each published as a separate volume, deal with highways and bridges; dredging and spoils disposal; marine construction; and small scale construction projects.

Hydrocarbon transmission and distribution pipeline projects in the Province of Ontario require the approval of an application by either the Ontario Energy Board (OEB) or the National Energy Board (NEB). All MOE concerns regarding such projects are forwarded to the OEB for inclusion, along with the concerns of other review agencies, in a coordinated response to a project application from a proponent. In most cases, then, proponents will make initial contact with the OEB to establish application procedures and regulations.

From a water resources perspective, many of the most critical concerns associated with pipeline construction arise during crossings of streams and lakes, where poorly planned construction activities often lead to excessive sediment production. The following document, therefore, concentrates on the watercourse crossing aspects of pipeline construction as they relate to the production of sediment. It has been prepared solely to outline fundamental principles and to specify those watercourse crossing considerations which may best assist proponents and MOE staff in (a) evaluating the potential adverse impacts of pipeline watercourse crossings, and (b) planning adequate mitigative measures.

INTRODUCTION

Good construction practice for watercourse crossing of transmission pipelines must ensure that every effort be made to preserve the physical and biological integrity of Ontario's waterbodies in accordance with the Provincial goals -- "To ensure that the surface waters of the Province are of a quality which is satisfactory for aquatic life and recreation" (Ontario Ministry of the Environment, 1978).

Each crossing must be examined on a site-specific basis; general characteristics such as size and flow are not in themselves reliable indicators of watercourse sensitivity. For this reason, arbitrary categorization of crossing techniques according to stream size is unacceptable. Care must be taken to ensure that each watercourse to be crossed is studied in sufficient detail to allow the best decision to be made regarding crossing technique and post-construction stabilization measures. The director of an MOE region may require that an appropriate water quality monitoring program be implemented for crossings of watercourses designated as "sensitive" by local MOE offices.

Watercourse crossings should strive for minimal impacts on water quality and water use by achieving:

1. the shortest possible construction time during the season of least disturbance;
2. limited instream disturbance; and
3. immediate implementation of post-construction stabilization measures.

The initial sections of the document provide background information on pipeline construction and associated adverse impacts of sedimentation. Subsequent sections outline a series of recommendations for the avoidance of common construction-related problems (and the rationale for these recommendations), and

environmental study report requirements pertaining to watercourse crossings. Finally, the implementation of environmental protection measures through contract specifications is outlined and a brief discussion of monitoring programme objectives is provided (for those crossings where they are deemed necessary).

1. OVERVIEW OF PIPELINE CONSTRUCTION OPERATIONS

Construction of transmission pipelines involves a variety of operations, many of which have the potential to produce large quantities of sediment. Details of these operations will depend on the size of the project, site specific conditions, and the contractor(s) involved. For the purposes of these guidelines, however, a series of general operations have been listed and defined below. Those which have the potential to increase sedimentation as the result of nearstream or instream erosion have been labelled.

OPERATION	DESCRIPTION
Clearing and Grubbing*	A variety of equipment is used to remove trees, stumps, and vegetation from the right-of-way (ROW).
Trenching*	Topsoil is selectively removed and stockpiled for use during site restoration and excavation equipment is used to cut the pipeline trench to required specifications (blasting may be required). Excavated material is usually stockpiled for use as backfill although in certain instances material will be trucked away and granular material will be brought in.
Preparation of Pipe	The pipe is hauled in from stockpiles and placed end to end, next to the trench. Where necessary a pipe bending machine is used to bend the pipe to required specifications.

OPERATION	DESCRIPTION
Welding, Cleaning and Coating	The pipe segments are aligned and welded to form a continuous line and rust and dirt are cleaned from the exterior of the pipe. It is then coated and inspected for coating faults.
Lowering-In	The pipe is placed in the trench.
Backfilling*	Damaged tiles (or those removed during construction) in nearstream agricultural areas are replaced, and the trench is selectively backfilled so that no material capable of damaging the pipe coating is placed against the pipe.
Hydrostatic Testing**	A mechanical scraper is sent through the pipe to remove rust, scales, and dirt, then water is pumped into the pipe until a designated pressure is achieved. If this pressure is maintained for the allotted test period (e.g. 24 or 48 hours) the line is considered acceptable and the water is discharged. If a leak is indicated through a loss of pressure, it is located and repaired and the line is retested.

Clean-up and Restoration	Construction-related debris is removed from the ROW and the area is restored to as near preconstruction conditions as possible.

* denotes operations having potential to increase sedimentation due to instream or nearstream erosion.

** certain applications may employ airpressure testing

2. IMPACTS OF CHANNEL EROSION AND SEDIMENTATION

Both instream and nearstream work have the potential to release large amounts of sediment which, if not controlled at the source, will be introduced into the watercourse. Depending on the grain sizes of the sediment and the watercourse flow, sediment may settle to form a bed deposit, become entrained as bedload, or become entrained as suspended load. In most cases a combination of the three occurs.

This chapter first examines the effects of sediment on the abiotic water environment and then discusses the resulting impacts on aquatic biota and watercourse users. It concludes with an assessment of sediment control practices.

2.1 Effects of Sediment on the Abiotic Water Environment

There will be both short-term and long-term effects on the aquatic environment associated with the construction and operational phases of pipeline watercourse crossings.

2.1.1 Short-Term Effects

Short-term effects are usually easily observed since instream and nearstream construction activity is concentrated in one location over a relatively short period of time. Large quantities of sediment may be almost instantaneously introduced into the watercourse, blanketing the channel bed and filling the water column with suspended particles. This has the potential to alter the light, temperature and water chemistry regimes of the watercourse. The downstream extent of the disruption will depend upon the individual watercourse, but in many cases effects are discernible at considerable distances from the original crossing site.

2.1.2 Long-Term Effects

Long-term sediment related effects tend to be secondary and are, therefore, usually less attributable to specific activities than short-term effects. They result from alteration to the regime of the watercourse due to local changes in bed and bank morphology and composition (i.e. altered depth, width, gradient, size of bed material).

Morphological changes induce altered flow patterns which in turn disrupt the local scour and fill (i.e. short-term in-channel erosion and deposition) equilibrium. In this way the effects can be transmitted both upstream and downstream, potentially altering conditions well removed from the point of initial disturbance.

The composition of bed and bank material can be altered by the introduction of imported backfill material, deposition of trench sediments, and the action of altered flow patterns.

The potential for long-term effects should not be overlooked and can be minimized through careful attention to site rehabilitation. The goal should always be to restore all disturbed areas at the crossing to as near preconstruction conditions as possible.

2.1.3 Sediment Chemistry

In some cases pesticides, herbicides, oil and grease, and other hazardous chemicals bonded to the sediment may be encountered during trench excavation. Although the risk of contaminant uptake by organisms and subsequent biomagnification through the food chain is less in those instances where contaminated sediments have been covered by clean deposits, trenching may reintroduce the contaminated material into the water column making it directly available to the ecosystem. It is, therefore, desirable to restrict bed disturbances to as small an area as possible.

In areas of known or suspected contamination the material to be removed during the trenching operations must be disposed of according to MOE's spoils disposal guidelines (Ontario Ministry of the Environment 1976).

2.2 Sedimentation Impacts on Aquatic Biota

The sedimentation effects of watercourse crossing will tend to result in certain adverse impacts on aquatic biota. For the purposes of the following discussion, the complex and interrelated components of the stream ecosystem have been separated into:

(a) primary productivity;
(b) benthic organisms; and
(c) fish.

However, interference with any part of the system has the potential to disrupt the stability of the entire system.

2.2.1 Primary Productivity

The photosynthetic production of organic matter by green plants e.g. plankton, algae etc. (autotrophs) is referred to as primary productivity. The increased turbidity (see Appendix I for definition), which results from the introduction of suspended sediment into the water column, attenuates the penetration of light and curtails photosynthesis, thereby adversely affecting one of the basic food sources of the aquatic environment. In those cases where in-channel vegetation is affected, a loss of protective cover may also result.

In order to prevent unnecessary adverse impacts upon primary productivity, every effort should be made to reduce the extent and duration of turbid conditions. This is best achieved by limiting construction in and adjacent to watercourses to the absolute minimum.

2.2.2 Benthic Organisms

The survival of benthic organisms depends upon the preservation of the watercourse substrate as suitable habitat. The most severe impact of sediment on the benthic community is the blanketing of the channel bed as the result of rapid sediment deposition. This either destroys the organisms or causes them to drift downstream (Hynes 1973). These bottom dwellers form a vital link in the aquatic food chain and dependent predators will be forced to abandon any region thus affected.

2.2.3 Fish

Increased turbidity adversely affects those species of fish which rely on sight for feeding and escaping from predators. Excessive sediment levels may also affect the respiratory mechanism of fish through clogging or abrasion of the gills although many species of adult fish are able to withstand high levels for extended periods of time by exuding a protective mucous on their skin and gills. Their survival is not assured, however, since the production of this mucous depletes their metabolic reserves at a time when the location of food is inhibited by the turbid conditions (Illinois EPA 1979).

Sediment can also clog the interstices of the substrate in fish spawning areas thereby interfering with the normal exchange of water which replenishes the oxygen supply and removes accumulated waste products. This impact can be lethal to emerging young (Illinois EPA 1979).

The loss of reproductive capacity through physiological stress, loss of spawning beds, and destruction of fry may result in a more significant negative impact on fish species than the direct short-term abrasion and clogging effects on adult fish. Although the damaged habitat may recover eventually, recolonization may be by less desirable species.

2.3 Impacts on Watercourse Uses

In addition to disrupting aquatic biota the turbidity resulting from construction-related sediment loads may also adversely affect various types of watercourse uses. These are summarized below.

2.3.1 Impaired Municipal/Industrial Water Supply

Depending on the extent and duration of turbid conditions and associated contaminants, and the treatment facilities available, there may be a temporary impairment or loss of water supply for municipal and/or industrial users. In some instances increased operational costs may result (e.g. increased backwashing) and equipment or facilities may be damaged creating a longer term disruption.

2.3.2 Flow Obstruction/Increased Flood Risk

Flow obstruction results from the formation of bars due to sediment deposition and can occur in channels of all sizes and types. The reduction in channel capacity through sediment accumulation may also be exacerbated by other types of construction debris. An increase in the frequency of overbank flows is the most common consequence of flow obstruction. These may inflict water and sediment damage on adjacent property and structures.

2.3.3 Damage to Artificial Structures

The long-term changes in scour and fill processes which may accompany short-term sedimentation effects can lead to the failure of such structures as bridges and culverts, while nearby structures may be endangered by bank failures.

2.3.4 Impaired Recreational Use

Both short-term and long-term effects have the potential to disrupt downstream recreation. Direct use of a water body for activities such as swimming will be curtailed by short-term increases in suspended sediment levels or other aesthetic parameters which result in an unpleasant appearance. Indirect uses, such as stream bank parks and trails, will suffer from such long-term effects as the loss of aesthetic value due to bank failures, and unsightly erosion and sediment control measures (e.g. concrete channel, gabion baskets).

2.4 Control of Construction Sediment

In the past, efforts to minimize erosional losses from areas of active construction have employed various control measures with varying degrees of success. The following extract, from a Ministry of the Environment study, reflects experiences to date with various control devices.

> A review of the existing data from the limited number of stream crossings that have been monitored indicates that some water quality degradation is inevitable. Many of the techniques employed to date (notably instream sediment traps) to minimize that degradation have been unsuccessful and only prolonged the construction period. Monitoring of properly carried out wet crossings suggests that the magnitude and duration of suspended sediment levels are not a direct threat to fish. By keeping the duration of construction to an absolute minimum it should be possible to keep the sediment load to the stream small enough to avoid habitat modification and burying of benthic invertebrates (Ontario Ministry of the Environment 1981).

This study suggests that the most important factor in the production of sediment from pipeline crossings is the amount of in-stream construction time, and that the best sediment control approach is to reduce this time to the absolute minimum. By reducing the quantity of sediment introduced into the watercourse the impacts of the previously outlined sediment-related effects can be diminished.

For streams that are particularly sensitive (downstream water uses, fish spawning activity, etc.) it may be necessary to adopt a "dry" crossing. Available evidence suggests that this technique is successful if the stream has a relatively stable low flow, the soils in the trench are sufficiently impervious that dewatering is practical and that care is taken with all other phases of the crossing.

3. RECOMMENDATIONS FOR REDUCTION OF WATERCOURSE CROSSING IMPACTS

This chapter outlines a series of recommendations which, if carefully applied, will help minimize the impacts of watercourse crossings on water resources. As indicated, reduction of instream work time is a fundamental objective and recommendations 1, 2, 3, 6, 7, 10, and 17 are directly related to this goal.

The section following the recommendations provides suggestions for the preparation of environmental study reports for pipeline projects, and the chapter concludes with a proposal for contract specifications and implementation to ensure that the recommendations are carried out.

3.1 Recommendations and Rationale

1. Comprehensive site-specific information should be compiled to allow adequate planning for route selection, construction techniques, mitigative measures, and site restoration (see Section 3.2).

   Many of the problems which arise during pipeline construction are the result of insufficient planning which fails to prepare the contractor for field conditions and which causes costly and environmentally damaging delays. A common example is the discovery, during trenching, of hard subsurface material where, according to a superficial field survey, none was thought to occur. In this case additional equipment is required and the crossing schedule must be altered to accommodate blasting (which must be timed to avoid impacts on fish migration or other water users). This type of delay, which occurs after instream work is under way, causes unnecessary increased erosion of cleared and cut areas.

   Local well records or geophysical survey data can often provide useful hints on subsurface conditions to be encountered although boreholes may be necessary in some instances.

2. <u>Appropriate equipment should be selected in advance to facilitate the rapid execution of the crossing operation.</u>

Contractors should not use equipment which is poorly suited to the specific crossing (e.g. too small, too large, too heavy, with insufficient reach etc.). In such cases, the equipment used must often operate from the stream bed or be transferred from one bank to the other causing further delay and resulting in degradation to both banks and bed.

3. <u>Clean backfill material should be stockpiled onsite to eliminate delays in areas where native material is not suitable for backfill.</u>

In cases where native material is not suitable as backfill it is common for the trench to be left unprotected until suitable material can be hauled in. This may lead to continuous erosion of the trench, or the sides of the trench may slump; in either case remedial work will be required, extending the construction period and potentially interfering with the post-construction stabilization schedule (if construction is extended into fall or winter the planned stabilization measures may be inadequate and increased erosional damage will occur during spring runoff).

4. <u>The decision to use sediment traps should be based on very careful planning since their use may create more problems than solutions</u>.

Over the last few years various devices have been used as sediment barriers including: snow fence with filter fabric, metal "A" frames with filter fabric, straw bales, and sandbag flumes. These have been unsuccessful from the standpoint of water quality protection and in many cases have resulted in significantly greater environmental damage than well planned,

swiftly executed wet crossings. For this reason general use of sediment traps is not recommended.

5. The method of stream crossing should be based on a site-specific evaluation.

   In determining the appropriate method of stream crossing, including selection of "wet" or "dry" methods, it will be necessary to evaluate all relevant factors. These will include: streamflow, stream width, environmental sensitivity, soil composition, streambank stability, and approach slope.

6. Dredging operations should not be conducted on prime recreational lakes during periods of peak use.

   Restriction on dredging operations is necessary in order to avoid degradation of water quality and aesthetic value by dredge related turbidity and to avoid physically restricting the movement of recreational boating. Where applicable the work may be scheduled to coincide with low water conditions (e.g. following annual drawdown).

7. Comprehensive pre-construction investigations and consideration of construction techniques should be undertaken in areas where sensitive materials, such as Leda clay, are likely to be encountered.

   The areas of Southeastern Ontario corresponding to the pre-glacial Champlain Sea (Ottawa Valley and St. Lawrence Valley) contain subsoils of marine origin. Many of the clay beds laid down at that time have a high water content and poor structure and as a result tend to fail when disturbed. The watery mass which results is both highly unstable and erodible. Unless adequate planning has resulted in the implementation of specific measures, construction activity can be severely hampered and an extreme amount of sediment can be introduced into the watercourse.

8. All site operations should be monitored and approved by an environmental inspector familiar with the construction plans and schedules for the specific project (see Section 3.3).

Inspection will ensure that the contractor complies with all design details and special provisions for environmental protection. It is imperative that the design details and special provisions be based on a thorough pre-construction investigation so that unexpected conditions do not result in major changes to construction plans. Both the inspector and contractor should review and familiarize themselves with the plans prior to activity in the field.

Minor changes, such as the substitution of one form of stabilization for another, can be accommodated in the field. However, they must be approved by the environmental inspector as being capable of achieving the same environmental management goal set out in the original construction plans. (For further detail see Section 3.3 Contract Specifications and Environmental Protection.)

(It is advisable that prior to the start of construction, site meetings be held between the proponent, the contractor, environmental inspector and government personnel to confirm site specific plan commitments).

9. Rapid completion of post-construction site restoration should be undertaken in order to minimize soil loss, especially during spring runoff.

Wherever possible, construction should be planned to allow completion sufficiently early in the growing season for vegetative stabilization measures to be put in place. In some areas (e.g. on very steep slopes or areas with highly erodible soils), additional measures will be required (e.g. mulches, chemical stabilization, nylon matting, etc.) until vegetative cover is firmly established.

If work is restricted to late in the season because of potential conflict with water uses (e.g. fisheries, recreation) during the summer season, special stabilization measures will be required. This will be especially important on steep banks and other sensitive slopes. Selected nursery stock and chemical soil binders should be employed immediately following construction to provide protection until spring planting, which will provide maximum erosion control.

Detailed arrangements regarding interim and final stabilization should be covered in the contract specifications and under no circumstances should a site be abandoned without the installation of adequate stabilization measures.

Planning for stabilization should incorporate as much geotechnical information as possible since the degree of difficulty associated with vegetative or structural re-stabilization of a site will determine construction technique. Steep or long slopes in combination with unstable soil will necessitate special construction techniques such as tunnelling, and will preclude any approach involving significant ground vibration such as blasting, since restabilization after the failure of such slopes will be difficult.

10. The backfilled trench should conform to the pre-construction channel configuration and excess material should not be disposed of in the watercourse, or anywhere where it could be reintroduced into the watercourse.

Restoration of the channel to as near preconstruction conditions as possible will minimize the potential for long-term effects resulting from alteration of the channel morphology and composition of the bed material.

11. When marine equipment such as floating dredges is used, the appropriate auxiliary equipment should be available for the removal of spoils to the designated disposal site.

Unless the dredge is capable of pumping the spoils to shore (e.g. hydraulic pipeline cutterhead suction dredge), transport of the dredge spoils will require the use of barges/scows and appropriate pump-out equipment at the disposal site.

In soft material it is sometimes possible to open a pipeline trench by means of a high pressure jetting device. This approach, however, is strongly discouraged, since it forces large quantities of sediment into the water column at considerable distances from the crossing site. This is especially undesirable in regions where contaminated sediments may occur, or where high suspended sediment and turbidity levels are intolerable.

For most inland watercourses, all trench spoils must be placed onshore unless the appropriate agency (e.g. MOE, MNR) approves their instream disposal. In major rivers (e.g. Ottawa, St. Clair) and lakes, the suitability of spoils for open water disposal will be determined by MOE's guidelines (MOE 1976).

12. Measures should be undertaken to ensure that the discharge of hydrostatic test water does not adversely affect water quality or cause scouring of the channel.

Use of gravel pads, strawbales, and discharge into dense vegetative ground cover are among those measures commonly employed to protect the stream channel from the impact of high velocity water in the vicinity of the test water outfall. In addition, aquatic biota should be protected from entrainment at the test water intake.

Rust and a variety of other materials may be removed during pipeline cleaning and it is necessary that all such material be collected and transported to an acceptable disposal site (if disposal is desired at other than an MOE approved site a rigorous analysis of the material will be required). The concentration of chemicals used in relation to pipeline cleaning should not be toxic to aquatic biota. MOE or other appropriate regulatory agencies (e.g. MNR) should be consulted on the use of such chemicals.

13. Stream diversions should only be used during watercourse crossings when no feasible alternatives exist.

Such operations may result in major erosional damage to the new channel and the subsequent introduction of sediment into the watercourse at the downstream point of confluence.

The use of diversions for dry crossings must be compared to other dry crossing techniques and consideration should be given to the approach which will result in the least degradation to the physical environment and water quality.

Additional problems associated with diversions relate to the disposal and stabilization of the large quantities of spoil from the new channel, and the post-construction restoration of the diversion channel.

Where approval for a diversion is given, MOE's guidelines for stream diversion should be followed (MOE 1976).

14. The use of rip-rap for stabilization of streambanks should provide protection from the channel bed to the high water line in order to prevent subsequent bank failure due to undercutting or washing out.

Field investigations have shown that although random dumping of rip-rap material over a streambank has, in many cases, protected the above-water region of the bank, the earth fill below the rip-rap is unprotected and eventually washes out, causing the entire bank to slump. This can lead to accelerated erosion and in some instances, quiescent embayments of poor water quality.

In order to avoid these problems rip-rap should be carefully placed on a correctly graded slope from the stream bed up to the high water-line.

15. Plugs should be left in place between the instream trench and the onshore main trench leading to the instream trench until immediately prior to the pipe laying operation to prevent erosional losses from the main trench gaining access to the watercourse.

Once the plugs are removed, a channelized access is provided to the watercourse and, depending upon the slope and soil type, a considerable amount of material may be eroded from the onshore trench and introduced into the watercourse.

A plug of approximately five metres in length (from the water's edge toward the top of the bank) will minimize the input of sediment to the watercourse.

16. Antiseep collars (breakers) should be used to impede subsurface drainage and thus reduce the washing out of subsurface material by piping.

In regions with long or steep slopes "internal erosion" caused by subsurface drainage around a newly placed pipe can be a serious problem leading to differential settling of the pipe and backfill. Impermeable barriers at appropriate intervals reduce the erosive force of the subsurface flow and encourage infiltration.

17. Aquatic vegetation which is removed prior to or during the trenching operation should be contained and adequately disposed of on land.

Vegetation which is allowed to drift downstream may adversely affect downstream users as the result of flow obstruction or choking of water intakes. Decaying vegetation may also cause odour and aesthetic problems.

18. Construction methods involving blasting operations should be approved in advance by all relevant agencies and parties (e.g. MOE, MNR, Conservation Authority, land owner).

Blasting operations within a watercourse has the potential to cause serious impacts on aquatic biota and watercourse users. Advance approval ensures that operations can be planned to cause minimal disruption.

19. Construction timing should be determined through consultation with MOE and MNR so as to avoid interference with the migration and spawning of particular fish species.

Disruption of spawning beds and impedance of migration, through degradation of water quality and the presence of instream machinery, may have serious consequences on the fisheries resource potential of a stream.

3.2 The Environmental Study Report

It is usual for the OEB to require that a proponent prepare an "Environmental Study Report" (ESR) which will be circulated to concerned agencies for review. That portion of the report covering watercourse crossings for a given project must include: an assessment of the existing environmental conditions, the rationale for selection of the proposed crossing site, an outline of mitigative measures, a description of the proposed undertaking, and an indication of the post-construction stabilization and restoration techniques that are to be employed.

Prior to the submission of the environmental study report, the proponent must ascertain the sensitivity of the watercourse involved since this will dictate the level of detail required. This will best be achieved through "pre-submission" of preliminary environmental assessment information for review by local Ministry staff and other concerned agencies. Such information would include photographs of the selected reach (e.g. 300 m upstream and downstream of the proposed crossing), a detailed map showing the location of the crossing, and a listing of native fish species in the river.

If there is any indication that water use will be adversely affected by the short-term and/or long-term impacts (see sections 2.2 and 2.3), then the watercourse may be designated "sensitive" and the type of approach outlined in section 3.2.1 should be used to document baseline conditions and plan construction procedures. The procedure for those streams which are not designated "sensitive" is outlined in section 3.2.2.

NOTE: Sections 3.2.1 and 3.2.2 are guidelines only and should not be interpreted as exhaustive listings of ESR requirements.

3.2.1 ESR Outline for Sensitive Watercourses

Existing Environment

A thorough description of the existing environment (pre-construction conditions) will be of value to both the proponent and reviewers. First, it provides interested parties with the quantitative data necessary for evaluating the degree of watercourse sensitivity and hence the rationale for the proposed crossing techniques. Second, it supplies the proponent with a set of environmental parameters to guide post-construction restoration.

This section of the submission should include the following information.

1. A discussion of topography and land use for the flood plain and valley walls will permit the estimation of the erosion potential over the right-of-way, as well as aiding in the selection of the most appropriate construction and site restoration methods.

2. Information regarding instream and nearstream subsurface conditions will be of great importance in the assessment of erosion potential and hence construction and restoration approaches. Such data as depth of water table, depth of bedrock, and overburden composition and structure will be necessary.

3. Data corresponding to the expected time of construction on such parameters as bankfull width and mean depth should be included in addition to low flow data such as stage, width, mean depth, mean velocity and discharge. These will allow the construction of channel cross section profiles and an assessment of the potential range of flows to be expected during the period of construction.

4. The presentation of grain size data for the stream bed material, and the sinking of bed cores to the proposed trench depth will provide a thorough knowledge of substrate conditions and will ensure that instream work is well planned and rapidly executed (i.e. no delays as the result of unanticipated subsurface conditions).

5. Wherever possible, water quality data indicating the usual annual range of parameters should be included as a means of assessing the <u>relative</u> impact of the crossing operation upon the watercourse.

6. Fish populations and spawning areas should be defined to assist in the selection of the most appropriate mitigative measures.

Proposed Undertaking

This section should provide a detailed description of the proposed undertaking and should include the type of information presented below.

1. The type of crossing should be indicated (i.e. wet or dry) and justified in terms of the baseline data provided in the description of the existing environment. This discussion should also provide a general indication of the type of equipment to be used.

2. Details of construction techniques and restoration scheduling should be provided for all instream and flood plain activities (see Section 1.).

3. Plan and cross sections of the watercourse and approaches should be provided indicating: the depth and alignment of pipe; the location of plugs, spoil piles and backfill stockpiles; and the placement of any temporary instream structures.

4. Mitigative measures and techniques to be used during construction should be highlighted. These will include: types of structures for the containment of spoils and backfill; backfill material specifications; procedures for land clearing and stockpiling; and equipment crossing restrictions.

5. Procedures for post-construction stabilization and restoration should be supplied. This will include a description of the various channel and flood plain stabilization measures with supplementary plan and cross sections showing their exact location and extent. A strategy for long-term restoration of the site to as near pre-construction conditions as possible should also be provided (i.e. in addition to any interim measures).

6. In some instances monitoring of construction and/or long-term impacts may be appropriate (see Section 4.0) in which case details of the program should be provided. In all cases contingency plans and emergency procedures for events such as spills, precipitation of unusual intensity and/or duration, or unexpected work stoppages should be provided.

3.2.2 ESR Outline for Other Watercourses (Non-Sensitive)

For those watercourses which have not been designated sensitive the same approach should be used (i.e. descriptions of the existing environment and proposed undertaking) but the level of detail contained in the submission need not be as high. The proponent should include the following minimum requirements:

(a) a brief description of the watercourse and bed material characteristics;

(b) an outline of crossing techniques, equipment and scheduling; and

(c) a site restoration plan.

This last item will be of the most significance since even in a watercourse where no user concerns have been identified prior to construction there is the potential for subsequent concerns as the result of long term impacts.

3.3 Contract Specifications and Environmental Protection

EXPERIENCE WITH PIPELINE CONSTRUCTION IN ONTARIO HAS SHOWN THAT THE INCLUSION OF ADEQUATE PROVISIONS FOR ENVIRONMENTAL PROTECTION IN THE ENVIRONMENTAL DOCUMENT SUBMITTED FOR REVIEW, DOES NOT ENSURE THEIR IMPLEMENTATION.

Frequently the practices carried out in the field vary greatly from the recommendations put forward in the assessment document. This places reviewers in the awkward situation of having approved a document on the basis of protective measures which are not implemented in the field.

The contract document appears to be the most feasible mechanism for ensuring compliance by the contractor with the conditions agreed to by the proponent and review agencies (through the appropriate energy board). The contract should reasonably reflect the requirements of the environmental document and to this end the contractor should be required to provide assurances that the environmental control measures are fully understood prior to finalization of the contract document. This could be achieved through submission of an implementation procedure document.

In addition, the contract should include provisions which would allow a duly appointed inspector to issue on-site written notices of violation for those instances when the contractor fails to comply with contractual obligations.

Finally, the contractor must provide assurance that all local, provincial, and federal regulations regarding watercourse pollution will be adhered to. Appropriate regulations must be cited and the procedure for compliance must be outlined.

4. MONITORING OF PIPELINE CROSSING IMPACTS

Although implementation of a monitoring programme is not required in all cases (at the discretion of the regional director of MOE), the sensitivity of a particular watercourse may require that an appropriate monitoring programme be carried out.

The results of any such monitoring programme will be of benefit in that they will enable the accumulation of a representative data base on various crossing techniques and mitigative measures for a variety of watercourse types. This information will assist regulatory agencies such as MOE, and MNR in evaluating impacts and control techniques and will allow the development of improved guidelines and recommendations for impact mitigation.

4.1 Monitoring Objectives

The fundamental purpose of a monitoring programme is to provide the data necessary for a quantitative assessment of the impacts of a watercourse crossing operation upon the watercourse environment. It should be undertaken with the intention of answering the following general questions:

1. How much sediment is being introduced into the system as a result of the crossing operation, and what is the effect on other water quality parameters?

2. What is the downstream extent of elevated sediment concentrations and related parameters, and where is the material being deposited?

3. How do sediment concentrations and related parameters vary over the construction phase, and are there any long-term changes from pre-construction levels?

4. What are the short-term and long-term effects on aquatic biota, and which communities are affected?

4.2 Data Analysis and Presentation

The specific data requirements for a study will depend on the methods of analysis and presentation which are to be used. It is, therefore, important that this information be included in a monitoring proposal which should be available for review by the respective regulatory agencies prior to implementation of the programme.

APPENDIX I

TURBIDITY AND SUSPENDED SOLIDS

Discussion of instream sediment load requires that the terms "turbidity" and "suspended solids" be defined since they are not synonymous.

"Turbidity" is a measure of the ability of water to transmit light. It is an optical property and depends upon the light scattering characteristics of material suspended in the water. Similar concentrations of various suspended particles (e.g. micro-organisms, organic debris, mineral particulates) will result in differing turbidity readings and it is, therefore, not generally feasible to develop a reliable correlation between turbidity and quantity of suspended solids. Photo-electric turbidity readings are commonly recorded in Jackson Turbidity Units (JTU), Formazin Turbidity Units (FTU), Turbidity Units (TU), and Nephelometric Turbidity Units (NTU) by means of a turbidity meter.

"Suspended solids" are reported either as sediment mass per volume water, or as sediment mass per mass water. The standard units are milligrams per litre ($mg\ L^{-1}$), and parts per million (ppm) respectively.

APPENDIX II

DRY CROSSINGS

If the use of a dry crossing is deemed necessary thorough investigations must be carried out to ensure that the technique will work safely and effectively. The following factors should be considered:

- erratic flow conditions (e.g. periodic large volume release from upstream reservoirs);

- anticipated river conditions during periods of high precipitation;

- the availability of a discharge area for water pumped during instream and nearstream trench dewatering and appropriate protection from erosion/scour;

- the influence of the local ground water conditions on the dewatering operation;

- provision for the removal and proper disposal of accumulated sediment from the sediment barriers; and

- the consideration of techniques for the proper placement and removal of devices so as to minimize disturbance to the stream bed.

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